In situ TEM measurements of mechanical properties of individual spherical BN nanoparticles of different morphologies

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Boron nitride (BN) nanostructures exhibit excellent mechanical properties. For example, the *in situ* tensile tests on individual BN nanotubes (BNNTs), which were conducted *in situ* in a transmission electron microscope (TEM) column, demonstrated the strength and Young’s modulus of ~33 GPa and ~1.3 TPa, respectively [1].Such superb mechanical properties of BN nanostructures make them very attractive materials as a reinforcement phase in lightweight composites. Besides nanotubes, nano-BN can be obtained in the form of spherical nanoparticles (BNNPs) with different morphologies – solid or hollow, with smooth or rough surfaces. High electrical and chemical resistance, thermal stability and biocompatibility of BNNPs were reported but their mechanical properties have not been detailed yet.

BNNPs in the present study were synthesized by CVD technique. By changing technological parameters of CVD process particles of various morphologies were obtained. For each type of individual BNNPs *in situ* compression tests were accomplished in a TEM column. As-synthesized BNNPs were dispersed in acetone and the suspension was placed onto a Si wafer. The truncated cone-like shape indenter with a diameter of top circle of 1 μm was used. Elastic moduli were determined for all tested particles. The obtained results (Fig. 1) show that the high strength enables the hollow spherical BNNPs to withstand a considerable compressive deformation before failure (up to 50% of the hollow particle diameter). The structures also demonstrated a high percentage of elastic recovery.

1. X.L. Wei, M.S. Wang, Y.Bando, D.Golberg, “Tensile tests on individual multiwalled boron nitride

nanotubes," *Adv. Mater*. 22 (2010), 4895-4899.

Figures:

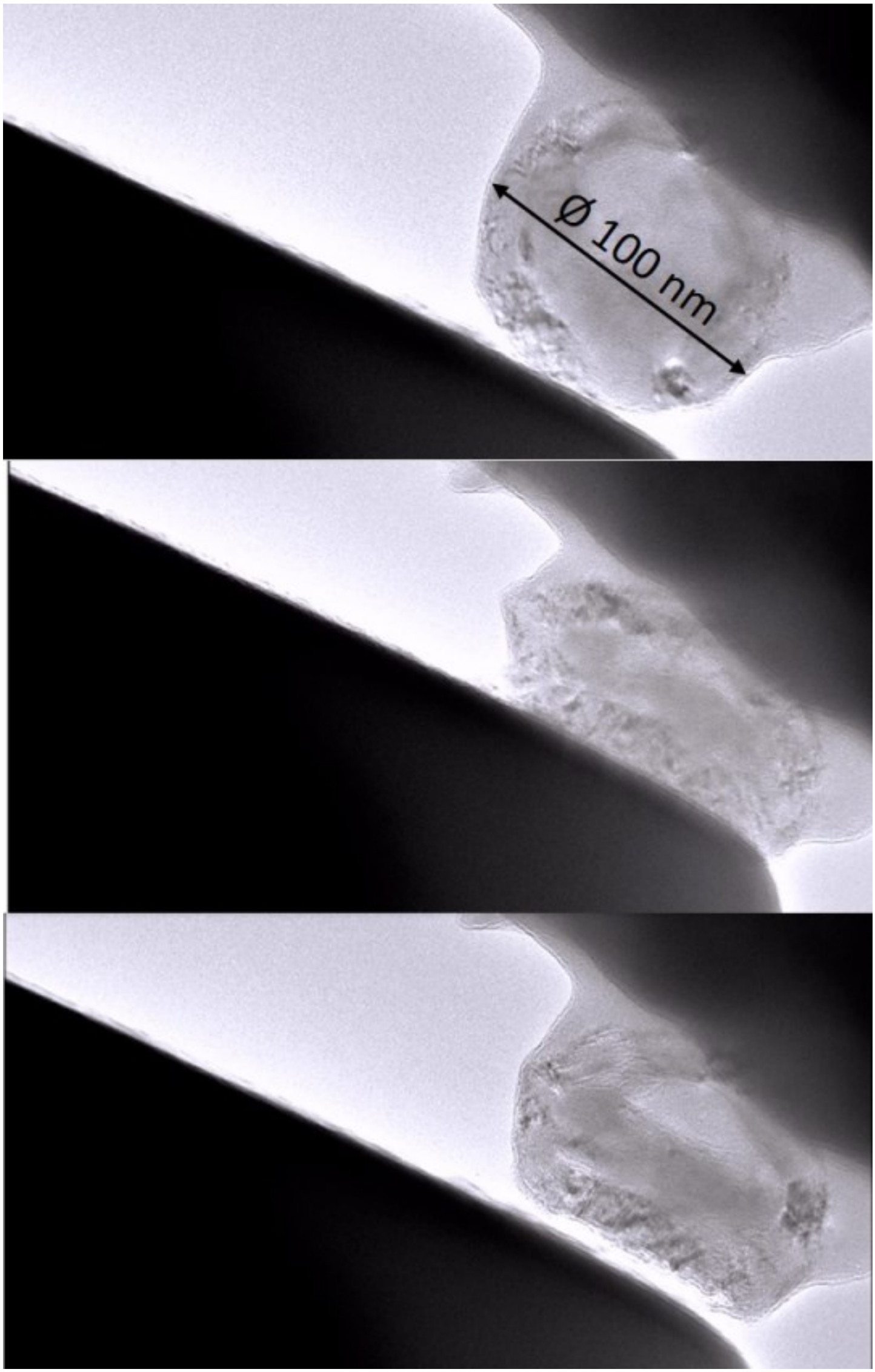

Figure 1. Compression test of individual hollow BN nanoparticle.